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(54) Optical fibre splicing

(57) In a method of effecting an end-to-end fusion splice between two optical fibres 1 each having a cladding or protective covering 2 of resin, the cladding or protective covering is removed from an end part 3 of each optical fibre and a sleev 4 of heat shrinkable plastics material is applied over one of the fibres. The fusion splice is effected between the exposed end parts 3 of the optical fibres 1, the heat shrinkable plastics sleeve 4 is positioned over the fusion splice, and resin 6 in a semi-fluid state is introduced into the mould cavity 5 formed by the sleeve 4 through one end of the sleeve. The sleeve 4 is heated to cause it to shrink to such an extent as to ensure that the mould cavity 5 is filled with resin 6, and the resin is permitted or caused to set and bond to the exposed parts 3 of the optical fibres 1 and to adjacent nds of the claddings r protective coverings 2.

Fig.1.

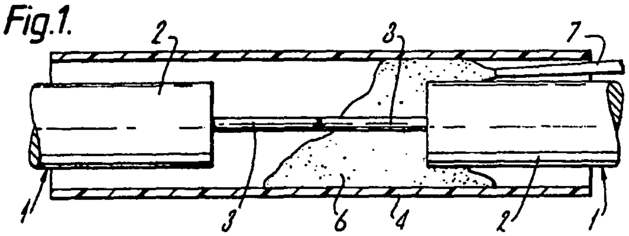

Fig.2.

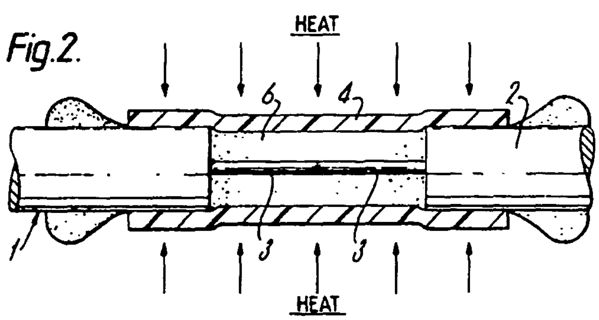

Fig.3.

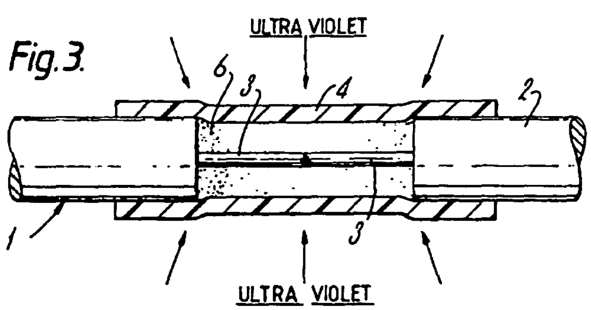

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Fig.1.

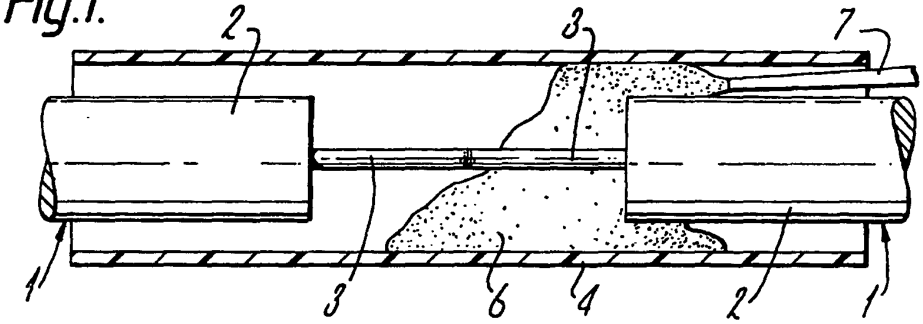


Fig.2.

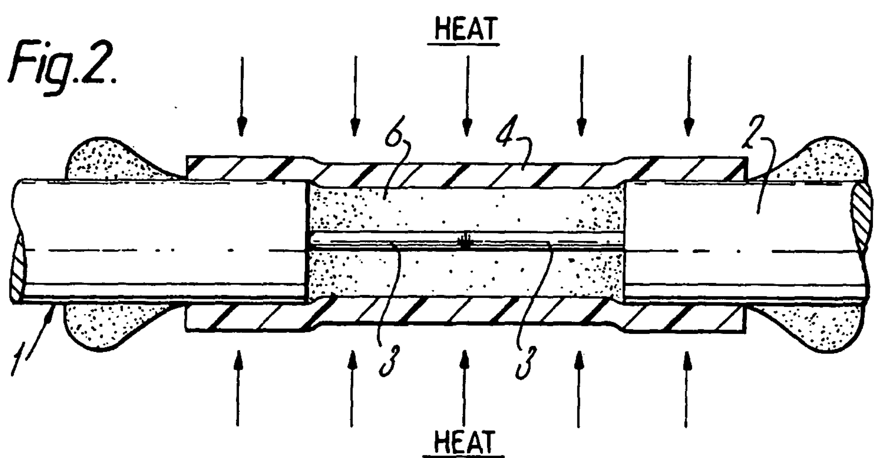
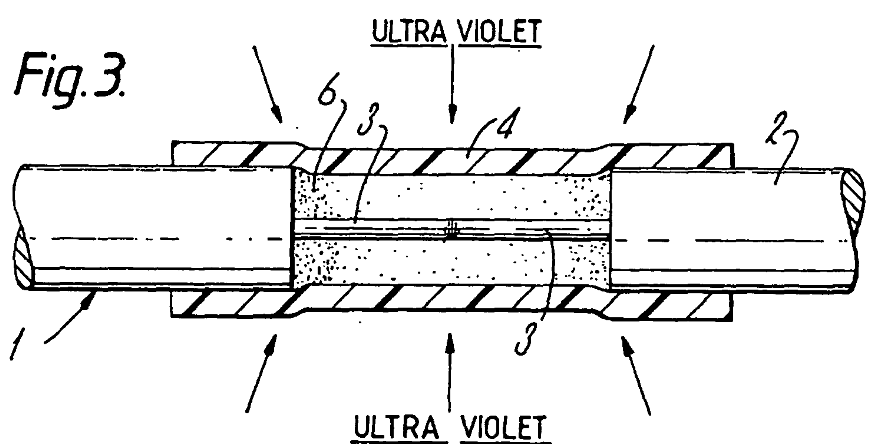


Fig.3.



SPECIFICATION

Optical fibre splicing

This invention relates to end-to-end fusion splicing of optical fibres and is particularly concerned with end-to-end fusion splicing of optical fibres having a cladding or protective covering of resin or other hardened plastics material.

When effecting an end-to-end fusion splice between two optical fibres each having a cladding or protective covering of resin or other hardened plastics material, it is the general practice to remove the cladding or protective covering from an end part of each optical fibre before effecting the fusion splice. After the fusion splice has been effected, it is desirable that the exposed fusion-spliced end parts of the optical fibres are re-clad or re-covered with resin or other hardened plastics material.

It is an object of the present invention to provide an improved method of effecting an end-to-end fusion splice between two optical fibres each having a cladding or protective covering of hardened resin or other hardened plastics material, which method can be readily and swiftly effected by semi-skilled or un-skilled personnel.

According to the invention the improved method comprises removing the cladding or protective covering of hardened resin or other hardened plastics material from an end part of each optical fibre; applying to one of the two optical fibres a sleeve of heat shrinkable plastics material so that it is spaced from the exposed end part of the optical fibre, the sleeve being of a length greater than the combined lengths of the exposed end parts of the optical fibres; effecting the fusion splice between the exposed end parts of the optical fibres; positioning the heat shrinkable plastics sleeve over the exposed fusion-sliced end parts of the optical fibres so that it overlies the adjacent end of the cladding or protective covering of each optical fibre to form a mould cavity; introducing resin or other hardenable plastics material in a semi-fluid state into the mould cavity through at least one end of the sleeve; heating the sleeve to cause it to shrink to such an extent as to ensure that the mould cavity is substantially filled with resin or other plastics material in a semi-fluid state; and permitting or causing the resin or other plastics material in the m uld cavity to set and bond to the exposed fusion splic d nd parts of the optical fibres and to the adjacent nds of the claddings r protective coverings of the optical fibr s.

The plastics sleeve may be r moved or, wh re desired, it may be retained over th fusion splice as a permanent verall prot ctive covering.

For convenience, resin or other hard nable plastics material in a semi-fluid state is introduced into the mould cavity preferably by means of a syringe. Heating of the sleeve is preferably effected by blowing hot air on to the sleeve. During heating of the sleeve, preferably the fusion-spliced optical fibres are held in tension. Surplus resin squeezed out of the ends of the sleeve when it shrinks can be removed by an absorbent wiper or other means.

The improved method of the invention is especially, but not exclusively, suitable for effecting a protected end-to-end fusion splice between two optical fibres of plastics clad silica which usually have protective coverings of a plastics material harder than that of the optical grade of plastics material of the cladding and which are generally of substantially greater overall diameter than composite optical fibres of glass and, in this case, it is preferred to retain the sleeve as permanent overall protection for the fusion splice.

Preferably, the bore of the sleeve of heat shrinkable plastics material is of substantially circular cross-section and, preferably also, the sleeve is heated to such a temperature and for such a time that it shrinks to such an extent that the resultant diameter of its bore is substantially equal to the overall diameter of the claddings or protective coverings of the optical fibres.

Any suitable heat-shrinkable plastics material may be used for the sleeve but it is preferred to employ cross-linked polyethylene which can be cause to contract to an extent sufficient to grip the adjacent ends of the claddings or protective coverings of the optical fibres when the sleeve is heated to a temperature of about 150°C. Other heat-shrinkable plastics materials that may be used for the sleeve include polyolefin, polyvinyl chloride, ethylene-vinyl acetate and a certain grade of polytetrafluoroethylene.

For encapsulating the optical fibre splice it is preferred to employ a resin which is curable by ultra-violet radiation and, in this case, the heat shrinkable material of the sleeve should be transparent to ultra-violet radiation. Where each optical fibre has a cladding of silicone resin, for encapsulating the optical fibre splice it is preferred to employ a silicone resin that can be cured by ultra-violet radiation. Thermally curable resin or other hardenable plastics material may be used for encapsulating the optical fibre splice if the sleeve is h at d to such a temperature and for such a time that it is fully shrunk.

The impr v d method of th inv ntion is especially, but not exclusively, suitable for use where optical fibres of c nventional length (say 2 km) are to b spliced in the factory in rd r to mak an optical fibre of abn rmally l ng length (say 10 km) of substantially uniform cross-secti n and/ r wh re, in the installation in which an optical fibr is to be em-

ployed, there is insufficient space to accommodate an end-to-end optical fibre splice with protective and/or reinforcing means hitherto proposed and used.

The invention also includes an optical fibre fusion splice made by the improved method as hereinbefore described.

The invention is further illustrated by a description, by way of example, of a preferred method of effecting an end-to-end fusion splice between two optical fibres each having a cladding of silicone resin, with reference to the accompanying drawing, in which:–

Figure 1 is a side view partly in section and partly in elevation of the fusion splice after end parts of the optical fibres have been fusion spliced.

Figure 2 is a similar view at a later stage in effecting of the fusion splice, and

Figure 3 is a similar view of the completed protected fusion splice.

Referring to the drawing, in effecting an end-to-end fusion splice between two optical fibres 1 each having a cladding 2 of silicone resin, the cladding is removed from an end part 3 of each optical fibre and a sleeve 4 of cross-linked polyethylene is applied over one of the optical fibres so that it is spaced from the exposed end part of the optical fibre. The length of the sleeve 4 is greater than the combined lengths of the exposed end parts 3 of the optical fibres 1. The fusion splice is effected between the exposed end parts 3 of the optical fibres 1 and the sleeve 4 is then positioned over the exposed fusion-spliced end parts so that it overlies the adjacent end of the cladding 2 of each optical fibre to form a mould cavity 5. Silicone resin 6 in a semi-fluid state is introduced into the mould cavity 5 through one end of the sleeve 4 by means of a syringe 7. The sleeve 4 is then heated by blowing hot air on to the sleeve to cause the sleeve to shrink radially inwardly to such an extent that the mould cavity 5 is reduced in volume and is substantially filled with silicone resin 6 in a semi-fluid state, any excess resin being squeezed out of the ends of the sleeve when it shrinks and removed by an absorbent wipe. The silicone resin 6 in the mould cavity 5 is then caused to set by the application of ultra-violet radiation so that it bonds to the fusion-spliced end parts 3 of the optical fibres 1 and to the adjacent ends of the claddings 2. The heat-shrunk sleeve 4 is retained over the fusion splice as a permanent overall protective covering.

CLAIMS

1. A method of effecting an end-to-end fusion splic b tween two optical fibr s each having a cladding or protectiv cov ring of hardened resin or other hard ned plastics mat rial, which method comprises r moving the cladding or protective covering of hardened r sin or other hard ned plastics material fr m an end part of each optical fibre; applying to one of the two optical fibres a sleeve of heat shrinkable plastics material so that it is spaced from the exposed end part of the optical fibre, the sleeve being of a length greater than the combined lengths of the exposed end parts of the optical fibres; effecting the fusion splice between the exposed end parts of the optical fibres; positioning the heat shrinkable plastics sleeve over the exposed fusion-spliced end parts of the optical fibres so that it overlies the adjacent end of the cladding or protective covering of each optical fibre to form a mould cavity; introducing resin or other hardenable plastics material in a semi-fluid state into the mould cavity through at least one end of the sleeve; heating the sleeve to cause it to shrink to such an extent as to ensure that the mould cavity is substantially filled with resin or other plastics material in a semi-fluid state; and permitting or causing the resin or other plastics material in the mould cavity to set and bond to the exposed fusion spliced end parts of the optical fibres and to the adjacent ends of the claddings or protective coverings of the optical fibres.

2. A method as claimed in Claim 1, wherein, after the resin or other plastics material in the mould cavity has set, the heat shrunk plastics sleeve is removed.

3. A method as claimed in Claim 1 or 2, wherein, during heating of the sleeve, the fusion-spliced optical fibres are held in tension.

4. A method as claimed in any one of the preceding Claims, wherein resin or other hardenable plastics material in a fluid state is introduced into the mould cavity through at least one end of the sleeve by means of a syringe.

5. A method as claimed in any one of the preceding Claims, wherein the sleeve is heated by blowing hot air on to the sleeve.

6. A method as claimed in any one of the preceding Claims, wherein the bore of the sleeve of heat shrinkable plastics material is of substantially circular cross-section and the sleeve is heated to such a temperature and for such a time that it shrinks to such an extent that the resultant diameter of its bore is substantially equal to the overall diameter of the claddings or protective coverings of the optical fibres.

7. A method as claimed in any one of the preceding Claims, wherein the sleeve is of a heat shrinkable plastics material which is transpar nt to ultra-violet radiation, the resin or other hard nable plastics material introduced into the m uld cavity is curabl by ultra-violet radiation, and the resin or oth r plastics material in the mould is caused to set by the application of ultra-viol t radiation.

8. A method of ffecting an end-to-end fusion splice between two optical fibr s substantially as hereinbefore described with refer-

ence to the accompanying drawing.

9. An optical fibre fusion splice made by the method claimed in any one of the preceding Claims.

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